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Investigations on the properties of solvent and dispersion adhesives for upholstered furniture. Part III. Thermoresistance of glue lines in PUR foams – wood or particleboard systems

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Abstract: *Investigations on the properties of solvent and dispersion adhesives for upholstered furniture. Part III. Thermoresistance of glue lines in PUR foams – wood or particleboard systems*. Thermoresistance of glue lines at static loadings for PUR foam - wood or particleboard systems was determined. The investigations of thermoresistance was carried out using the prototype instrumentation executed in conditions of the MEBLOMAR Comp., whose essentia relied on the exertion of different static loadings. Thermoresistance of tested glue lines was expressed with the degree of their percentages delamination (PUZ). It was stated, that glue lines from dispersion adhesives with static loadings showed higher thermoresistance, than solvent systems. Dispersion 1C adhesive had shown highest thermoresistance and even at the loading of 1 kg in the temp. 130°C, did not surrender delamination.

Keywords: solvent adhesive, waterborne adhesive, upholstery furniture, glue line, loading, thermoresistance

INTRODUCTION

In previous parts our studies (Krystofiak et. al 2013a, b) was investigated properties of solidified adhesive layers and thermoresistance of glue lines from upholstery adhesives in foam PUR materials across the cyclic temperature rise. In industrial practice usually flexible facing materials are joined with the skeleton construction performed from wood or wood based materials in the form of particleboards, MDF or HDF (Proszyk & Pajdosz 1995, Sedliačik & Sedliačiková 2009, 2010). Bearing in mind the specificity of lignocelulose materials and the possibility of the appearance of stresses was decided to carry out investigations, whose aim was the determination of thermoresistance of glue lines at static loadings appropriately for PUR foam - wood or particleboard systems.

EXPERIMENTS

For the evaluation of thermoresistance of glue lines at static loadings was chose PUR foam with commercial sign T-20 (dimension of samples 100 x 100 x 100 mm), to which was glued elements from pine wood (*Pinus sylvestris* L.) and the particleboard of the general purpose (150 x 100 x 19 mm). The gluing processes of foam-pine wood, foam-particleboard system was realized at the use of solvent binding agents (Jowatac 456.34 conventional and Jowatac 456.54 HS) in the MEBLOMAR Comp. with the seat in Siedlec town, however of dispersion (2C Jowatac 414.10 with the hardener 414.80 and 1C Jowatac 414.50) in the laboratory of the JOWAT Poland Comp. in Sady /n Poznań. Solvent adhesives were applied on foams surfaces one- or two sides in the quantity 130±5 g/m^2, however the dispersion products in the quantity 180 g/m^2. Then after the lapse approx. 90 s were glued to them elements from wood or the particleboard to particular foams. The investigations of thermoresistance was carried out using the prototype instrumentation executed in conditions of the MEBLOMAR Comp. in Siedlec, whose essentia relied on the exertion of different static loadings. Whereat on the basis of preliminary results of experiences was accepted maximal loading 1 kg. Thermoresistance of tested glue lines was expressed with the degree of their percentages delamination (PUZ).

RESULTS

In the Tables 1 and 2 was presented the comparison of the coefficient PUZ value during the thermoresistance test under the static loading for solvent and of dispersion adhesives at the joining of foams suitably with pine wood and particleboard. From the general data analysis it was stated, that results for solvent adhesives in connection with these materials showed higher thermoresistance, than in the typical foam - foam system. This is caused of the properties of these materials, and especially as it should be suppose them the decidedly, first of all density and porosity. Glue lines from the 1C adhesive dispersion showed high thermoresistance. In the temperature 130°C at the static loading (1 kg) of the connection did not surrender to the delaminations, what predisposes it to the application in systems particularly exposed on the influence of the heat. Furthermore was observed that glue lines obtained from this binding agent had kept both the elasticity, and the stabile colour.

Tab. 1 Comparison of PUZ coefficient during thermoresistance test under the static loading 1 kg for various adhesives by two sided application at the joining of foam – wood systems

Temperature [^{o}C]	Kind of adhesive			
	Solvent		Dispersion	
	456.34	456.54	1C	2C
	PUZ [%]			
30	0	0	0	0
40	0	0	0	0
50	0	0	0	0
60	40	30	0	0
70	100	100	0	20
80	-	-	0	100
90	-	-	0	-
100	-	-	100	-

Tab. 2 Comparison of PUZ coefficient during thermoresistance test under the static loading 1 kg for solvent and dispersion adhesives at the joining of foam – wood system by two sided application

Temperature [^{o}C]	**Kind of adhesive**			
	Solvent		**Dispersion**	
	456.34	**456.54**	**1C**	**2C**
	PUZ [%]			
30	0	0	0	0
40	0	0	0	0
50	0	0	0	0
60	20	0	0	0
70	100	25	0	15
80	-	100	0	100
90	-	-	0	-
100	-	-	0	-
110	-	-	0	-
120	-	-	0	-
130	-	-	0	-

In Tables 3 and 4 was given results of thermoresistance of connections in foam-wood and foam-board systems for solvents adhesives by one- and two-sided application. Analysing present data generally was stated, that glue lines obtained in the process of the two-sided application show higher thermoresistance. These systems in case of the Jowatac 456.54 adhesive in comparison with results of connections at one-sided application, showed higher about 20°C the level of thermoresistance. However for glue lines from the 456.34 adhesive this resistance was higher about 10°C. It is proper to mark, that in case of connections foam-pine wood during the warming process was observed the migration of components of natural

resins, which influenced on the delamination of glue lines, and what this is going lowering their thermoresistance.

Tab. 3 Comparison of PUZ coefficient during thermoresistance test under the static loading 1 kg for solvent adhesives at the joining of foam – wood system by one- and two-sided application

Temperature [°C]	Kind of adhesive			
	456.34		456.54	
	Application			
	One-sided	Two-sided	One-sided	Two-sided
	PUZ [%]			
30	0	0	0	0
40	0	0	0	0
50	30	0	20	0
60	100	40	100	30
70	-	100	-	100

Tab. 4 Comparison of PUZ coefficient during thermoresistance test under the static loading 1 kg for solvent adhesives at the joining of foam – particleboard system by one- and two-sided application

Temperature [°C]	Kind of adhesive			
	456.34		456.54	
	Application			
	One-sided	Two-sided	One-sided	Two-sided
	PUZ [%]			
30	0	0	0	0
40	0	0	0	0
50	20	0	20	0
60	100	20	100	0
70	-	100	-	25
80	-	-	-	100

One ought to mention, that during the test of the mechanical disconnection of glued materials the delamination stood in the substrate, and not in the glue line. This testifies about the creation through solvent and of dispersion adhesives of very resistant connections, both in the foam-wood, as and foam-chipboard systems.

RECAPITULATIONS

Glue lines from dispersion adhesives with static loadings showed higher thermoresistance, than solvent systems. It was stated, that the dispersion 1C adhesive had shown highest thermoresistance and even at the loading of 1 kg in the temp. 130°C the connection did not surrender of delamination, what predisposes it to the application in systems of particularly exposed on the heat influence.

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Streszczenie: *Badania właściwości klejów rozpuszczalnikowych i dyspersyjnych przeznaczonych do produkcji mebli tapicerowanych. Cz. III. Termoodporność spoin w układach pianka PUR – drewno lub płyta wiórowa*. Do oceny termoodporności spoin obciążanych statycznie wytypowano piankę PUR o oznakowaniu handlowym T-20, do której przyklejano próbki z drewna sosny oraz płyty wiórowej. Proces klejenia poszczególnych układów realizowano przy użyciu środków wiążących rozpuszczalnikowych (Jowatac 456.34 konwencjonalny i Jowatac 456.54 HS) i dyspersyjnych (2K Jowatac 414.10 i utwardzacz 414.80 i 1K Jowatac 414.50). Badanie termoodporności przeprowadzono wykorzystując prototypowe oprzyrządowanie wykonane w uwarunkowaniach firmy MEBLOMAR w Siedlcu. Na podstawie wyników przeprowadzonych badań stwierdzono, że kleje dyspersyjne wykazały w układzie relatywnym wyższą termoodporność spoin przy obciążeniu statycznym. Spoiny z kleju dyspersyjnego 1K wykazały całkowitą termoodporność w temp. 130°C przy obciążeniu statycznym 1 kg.

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